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October 29, 2010  
Ms. Carmel Hood  
Document Control Center  
Arizona State Corporation Commission  
1200 West Washington Street  
Phoenix, Arizona 85007

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OCT 29 2010

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*[Signature]*

RE: Request by DPA for a 10-year Extension of Time Limitation of the ACC CEC for the NTP.  
Docket: L-00000U-00-0103 and Decision: 63197

Dear Ms. Hood:

This letter will serve as a formal request by the Diné Power Authority (DPA) to the Arizona Corporation Commission (ACC) for an extension of time limitation of the Certificate of Environmental Compatibility (CEC) for the Navajo Transmission Project (NTP), from November 30, 2010 to November 30, 2020. In the CEC, the ACC has provided eight conditions with the authorization to DPA to construct a new 500 kV transmission in Arizona, on the non-reservation portions of the proposed and alternative routes for the NTP.

Briefly, the CEC, under condition 1, reads as follows:

"The authorization to construct the new transmission line will expire ten (10) years from the date the Certificate is approved by the Arizona Corporation Commission, unless construction is completed to the point that the line is capable of operating at its rated capacity by that time; provided, however, that prior to such expiration the Applicant may request that the Arizona Corporation Commission extend the time limitation."

DPA is an enterprise of the Navajo Nation that has an approved long-term 250-mile right-of-way (ROW) for the NTP across Navajo tribal trust lands from Hogback, New Mexico to the western border of the Navajo Reservation near Gray Mountain, Arizona. The CEC covers the non-reservation portion of the NTP from the Moenkopi Substation to the Nevada border for 181 miles. After exiting the tie-in at the Moenkopi Substation, the transmission line route crosses additional Navajo Reservation lands, the Kaibab National Forest, the Big Boquillas Ranch (Navajo-owned fee land), and a patchwork of other federal, state, and private lands. The route is located south of the Hualapai Indian Reservation and crosses through the Lake Mead National Recreation Area and the Colorado River into Nevada, connecting with Marketplace Substation. Maps from the original CEC application depicting the location of the entire project as well as the portions specifically addressed in the CEC application are included as attachments.

The 500kV electric transmission line and associated facilities are designed to deliver power between the Four Corners area and the Desert Southwest. The proposed NTP parallels existing high-voltage transmission lines that have little or no capacity remaining to meet the increasing electricity demand throughout the Desert Southwest and California. The NTP would improve the capacity, flexibility, and overall efficiency of transmission in the growing and increasingly underserved region. The project would provide economic benefits to the economically disadvantaged Navajo Nation. Thus, DPA is

continuing to work to develop the NTP for which a Final Environmental Impact Statement (EIS) was completed, and a Record of Decision (ROD) was originally awarded in 1997 by the United States Department of Energy.

The need for the NTP in the EIS remains unchanged, and is restated here, as follows:

1. Relieve the constraints on the transmission of electricity west of the Four Corners area.
2. Improve the operational flexibility and reliability of the extra-high-voltage transmission system in the region.
3. Allow increased economical power transfers, sales, and purchases in the region.
4. Improve economic conditions of the Navajo Nation.
5. Facilitate the development of the Navajo Nation energy resources and its participation in the electrical utility industry.

In November 2002, the Resources Committee of the Navajo Nation Council approved and granted two (2) 50-year ROWs to DPA to utilize certain Navajo trust and fee lands for construction of the NTP in New Mexico and Arizona. Each ROW has an option for an additional 50-year term upon approval by the Navajo Nation. The tribal fee land is in the Big Boquillas Ranch area, and DPA has the ROW across this area, which is located between the Kaibab National Forest and the Hualapai Reservation. The CEC by the ACC and the effective ROWs by the Navajo Nation comprise a very substantial part of the NTP route in New Mexico and Arizona. The request for extension of the CEC for an additional 10 years will help keep the NTP approvals current so that the project can be developed. This new extension of time limitation will help DPA work and participate in the electrical energy market as well as help the Navajo Nation accomplish beneficial energy projects.

Following the earlier approvals, several federal agencies have continued to investigate and evaluate the NTP for more than a decade. In 2003 DPA signed a development agreement with Steag Power (later to become Sithe Global Power) to develop a 1,500-megawatt (MW) power plant, the Desert Rock Energy Project (DREP) in the Four Corners area. As a part of this development, the eastern portion of the NTP (Segment 1), from the Four Corners area to the planned Red Mesa Substation is proposed as a portion of the transmission interconnection for the project. Additionally, Segment 2 (Red Mesa Substation to Moenkopi Substation) was considered as an option in the development agreement. For the power plant and interconnection, the lead federal agency for the EIS studies was assigned to the Department of the Interior, Bureau of Indian Affairs (BIA), with the Bureau of Land Management (BLM) assigned as a cooperating agency. In autumn of 2008, the BLM and the BIA, respectively, issued updated records of decision (RODs) granting DPA the ROWs necessary to proceed with this project on all Navajo tribal lands. On September 29, 2008, BLM's Kingman Field Office issued an updated Record of Decision for the Right-of-way Grant AZA30892 and Right-of-way Grant AZA39782A (BLM ROD). On October 8, 2008, the BIA issued its updated Record of Decision for the NTP (BIA ROD). However, these RODs are currently under appeal.

The DREP is currently undergoing delays and challenges due to the shift in power demand from coal to renewable energy sources. In 2005, DREP had an initial offtake potential with DREP's response to request for proposals by the Arizona Public Service Company and Salt River Project, for up to 900 MWs and 600 MWs, respectively. However, in 2009, the companies informed DPA and Sithe Global Power (Sithe), our energy development partner, that the major utilities in Arizona are now being required by the state to look for renewable energy rather than coal-fired power. Additionally, DPA was informed that some major utilities that have ownership in the existing coal-fired generation

were told to retire their coal-power-generation assets and not to take any more power purchase agreements from coal-based power generators. In short, DREP lost its power offtake potential.

In keeping with the changes in the Southwest power market, DREP is being placed on hold until we can resolve issues with (1) the carbon footprint for the project, (2) the uncertainty associated with new congressional legislation on carbon and regulations on new emissions controls under the emerging federal laws, and (3) the shift in power demand from fossil fuels to renewable energy.

Recently, as renewable-energy resources have become favored over fossil-fuel-based power generation, the need has shifted to the development of transmission for new renewable-energy projects (including wind and solar). We believe that the NTP could also be used to directly support new renewable-energy development.

DPA is created by tribal statute to conduct activities dealing with renewable energy research and development, and related power and energy development on the Navajo Reservation necessary to vertically and horizontally integrate the Navajo Nation's power, utility, and resource infrastructure. For example, in 2008, the Navajo Nation President assigned a wind energy project to the Navajo Tribal Utility Authority. DPA is also evaluating a 200-MW to 500-MW solar-energy farm on the tribally-owned Big Boquillas Ranch. DPA is conducting due diligence and evaluating the available transmission capacity in the area and looking for opportunities to build the NTP in association with Navajo development of renewable-energy projects.

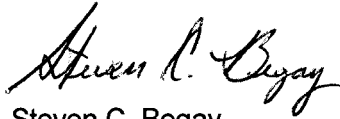
There are also new entities that are interested in the opportunity to evaluate the NTP for a high-voltage transmission line for renewable-energy power from eastern New Mexico to southern Nevada. A number of internal-tribal and private business entities are discussing several wind and solar projects on the Navajo Reservation. They are looking for transmission capacity in the near future to sell power to areas in the southwestern United States. Currently, the NTP is designed as a high-voltage line from the Four Corners area to southern Nevada where several transmission interconnection substations exist that can accommodate that transfer of power in the broader Southwest power market. If no new fossil-fuel-based power generation is developed in the future, then it is very likely that the entire NTP will be built for renewable-energy transmission.

Furthermore, there are many renewable-energy projects being proposed specifically in Arizona and upgrades and new transmission lines are being proposed to handle new loads in central Arizona. DPA has attended several meetings and work sessions with the Southwest Area Transmission (SWAT AZ/NM) task groups from Arizona and New Mexico. There are ongoing Western Electricity Coordinating Council (WECC) studies being conducted in the Desert Southwest wherein the NTP information serves as a valuable asset in consideration for feasibility and path rating studies. As an example, I have attached a report, entitled, Southern Navajo (Path 51) Upgrade Project, WECC Accepted Rating Report.

Above, DPA has provided a summary of the reasons why DPA was unable to comply with the original Arizona Corporation Commission due date, and the circumstances under which DPA is continuing to respond to the changing energy development environment. As stated earlier, the need for NTP, as currently proposed, remains valid. DPA, under its legislated authority will continue to develop the NTP and requests an extension of time limitation of the CEC to accomplish its overall goals in addressing this need, and constructing the NTP.

Thank you for your time and attention, and DPA requests your favorable consideration and decision regarding this matter. Please feel free to contact me, or Ben Hoisington, Project Administrator at DPA, by calling telephone 928-871-2133 to discuss any questions that you may have.

Sincerely,  
DINÉ POWER AUTHORITY



Steven C. Begay  
General Manager

Cc: Chrono/file  
Shannon Kanlan, Utilities Division, ACC, 1200 W. Washington St., Phoenix, AZ 8500  
Compliance Section, ACC, 1200 W. Washington St., Phoenix, AZ 85007

Enclosures: Project Location Map  
Map Illustrating the Location and Facilities Addressed in the CEC Application  
Jurisdiction and Land Status Map  
Southern Navajo (Path 51) Upgrade Project, WECC Accepted Rating Report

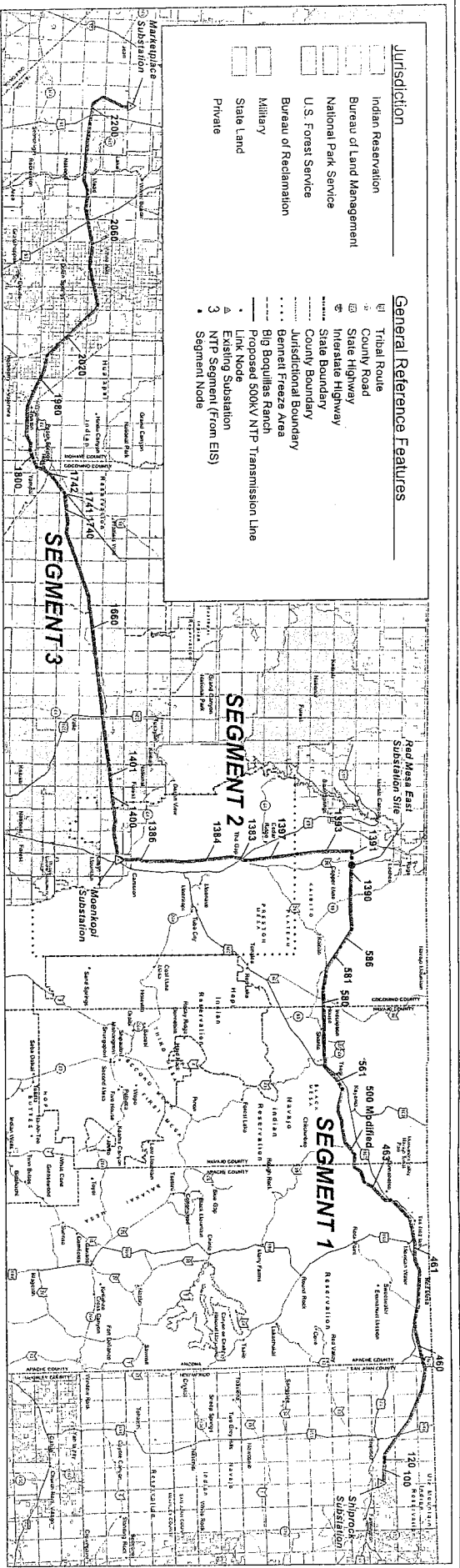
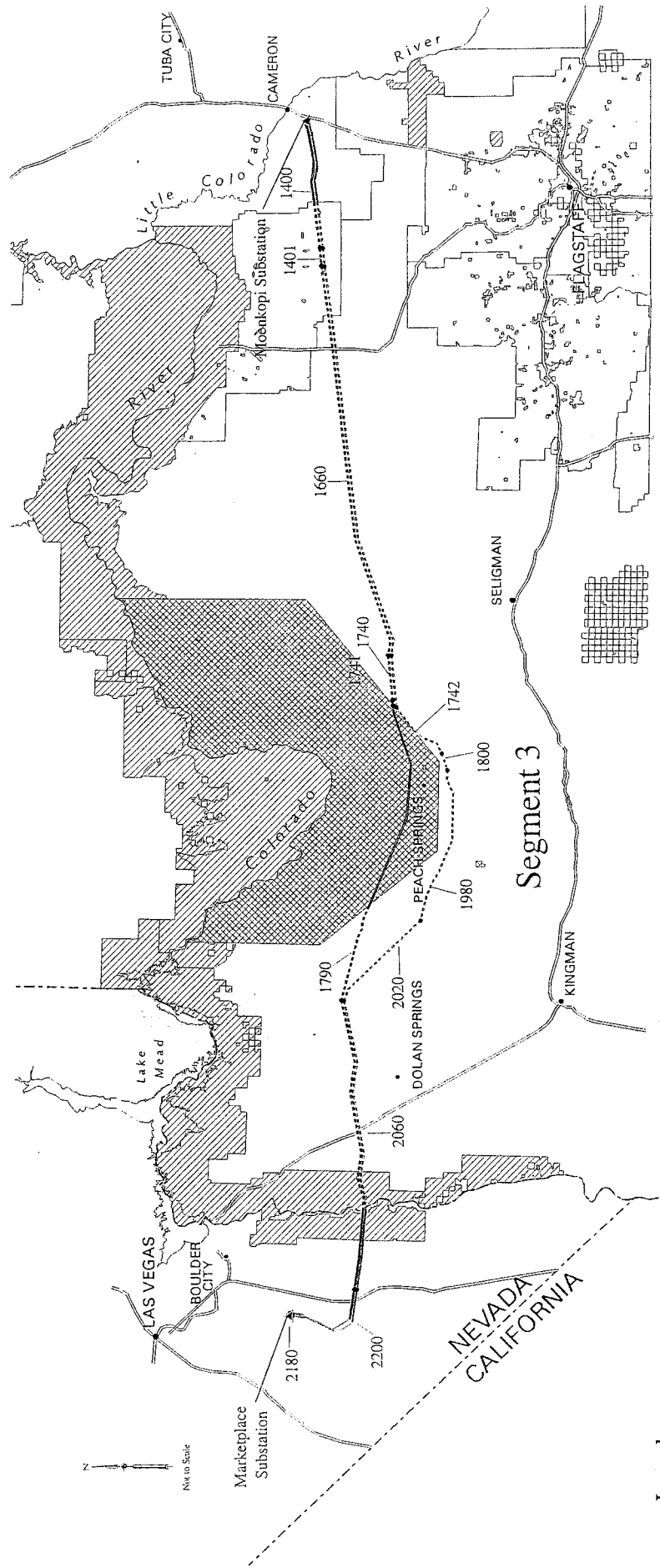


Figure 1  
PROJECT LOCATION  
Navajo Transmission Line Project



### Legend

- |  |   |  |                                      |
|--|---|--|--------------------------------------|
|  | Navajo Indian Reservation                               |  | Preferred Route                      |
|  | Hopi Indian Reservation                                 |  | Locations Requiring CEC Approval     |
|  | Hualapai Indian Reservation                             |  | Locations of Non-CEC Approval        |
|  | National Parks and Recreation Areas                     |  | Alternative Route                    |
|  | National Forests  |  | Locations Requiring CEC Approval     |
|  | State, Private, Municipal, or Bureau of Land Management |  | Locations of Non-CEC Approval        |
|  |   |  | 1980 - Transmission Line Link Number |
|  |   |  | ▲ Substation Sites (Non-CEC)         |

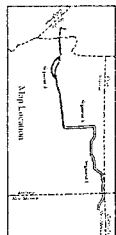
**Location of Facilities  
Addressed in the CEC**  
Navajo Transmission Project,  
Figure 2

\\dsk02\jnp\ceca\mtd\fig2\ceca.mxd September 27, 1999

# Jurisdiction and Land Status

## NAVAJO TRANSMISSION PROJECT

Final Power Authority, Navajo Nation



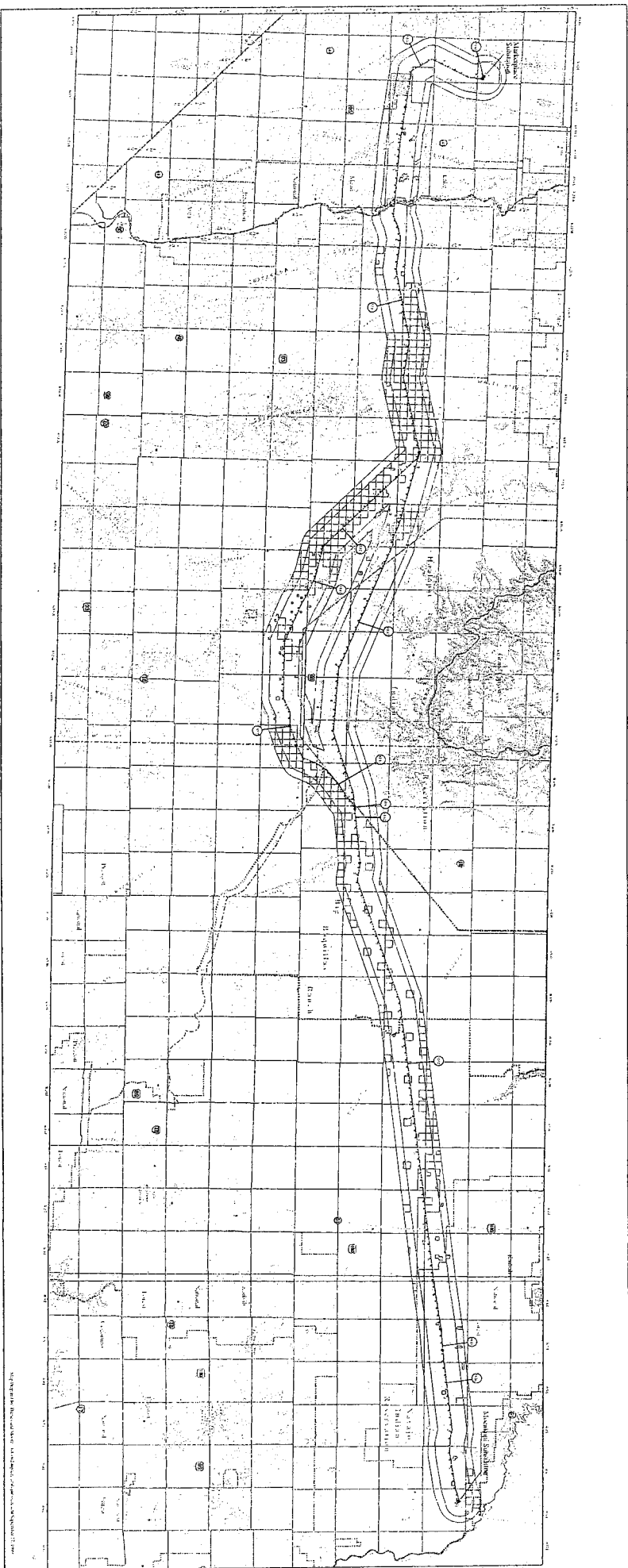
### General Reference Features

- ① Trail Route
- ② County Road
- ③ State Highway
- ④ Interstate Highway
- ⑤ Alternative Suburban Sites
- ⑥ State Boundary
- ⑦ County Boundary
- ⑧ Indian Boundary
- ⑨ Indian Free Area
- ⑩ Big Boyville Ranch

### Resource Inventory

- FEDERAL**
  - ☐ Bureau of Land Management (BLM)
  - ☐ BLM Land Sale Withdrawal
  - ☐ U.S. Forest Service
  - ☐ National Park Service
  - ☐ Bureau of Reclamation (BOR)
  - ☐ BOR Withdrawal
- AMERICAN INDIAN**
  - ☐ Navajo Indian Reservation
  - ☐ Navajo Individual Indian Allotment
  - ☐ U.S. Protected Lands in Trust for the Navajo Indian Reservation
  - ☐ Hopi Indian Reservation
  - ☐ Headright Indian Reservation
- STATE**
  - ☐ State Land
- PRIVATE**
  - ☐ Private Landholdings

### Inventory Key



### SOURCES:

Navajo Nation  
Bureau of Land Management (BLM)  
U.S. Forest Service  
U.S. Department of the Interior  
U.S. Department of Energy  
U.S. Department of Agriculture  
U.S. Department of Commerce  
U.S. Department of Defense  
U.S. Department of Education  
U.S. Department of Health and Human Services  
U.S. Department of Housing and Urban Development  
U.S. Department of Justice  
U.S. Department of Labor  
U.S. Department of State  
U.S. Department of Transportation  
U.S. Department of Veterans Affairs  
U.S. Environmental Protection Agency  
U.S. Geological Survey  
U.S. Indian Affairs  
U.S. National Aeronautics and Space Administration  
U.S. National Science Foundation  
U.S. Nuclear Regulatory Commission  
U.S. Social Security Administration  
U.S. Supreme Court  
U.S. Supreme Court  
U.S. Supreme Court

August 1999

DPA



# **Southern Navajo (Path 51) Upgrade Project**

## **WECC Accepted Rating Report**

October 23, 2009

*Final*



Prepared for the  
Southern Navajo Participants &  
the Path 51 Upgrade Project Review Group



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## I. EXECUTIVE SUMMARY

In 2005 Arizona, Arizona Public Service and the Southern Navajo participants (Salt River Project, United States Bureau of Reclamation and Tucson Electric Power) started the design process for replacing the four series capacitors on the Southern Navajo (WECC Path 51) system. Path 51 is comprised of the sum of flows on the Navajo-Westwing and Moenkopi-Yavapai 500 kV lines. A feasibility study was performed to determine if the Path 51 rating could be increased based on different series capacitor upgrade scenarios. An upgrade option was selected utilizing both compensation and ampacity levels for all four banks that would support a new accepted rating of 3100 MW. The present accepted rating for the path is 2264 MW and was established in August 1994. In September 2005, the Navajo Transmission System Engineering and Operations Committee authorized the study effort to obtain a new accepted rating for Path 51 based on the upgrades. In 2006 the Southern Navajo participants initiated the WECC Project Rating Review process (as outlined in WECC's *Overview of Policies and Procedures for Regional Planning Project Review, Project Rating Review, and Progress Reports*) for obtaining a new accepted rating for the path. In 2007 the Comprehensive Progress Report showing the upgrade project supporting a new rating of 3200 MW was issued to WECC and a request was made to form a project review group. A group was formed within the Western Arizona Transmission System (WATS) task force and in November 2007 phase II status was achieved. In 2008, the Southern Navajo participants prepared and completed a study plan with the help of the WATS task force for performing the phase II studies.

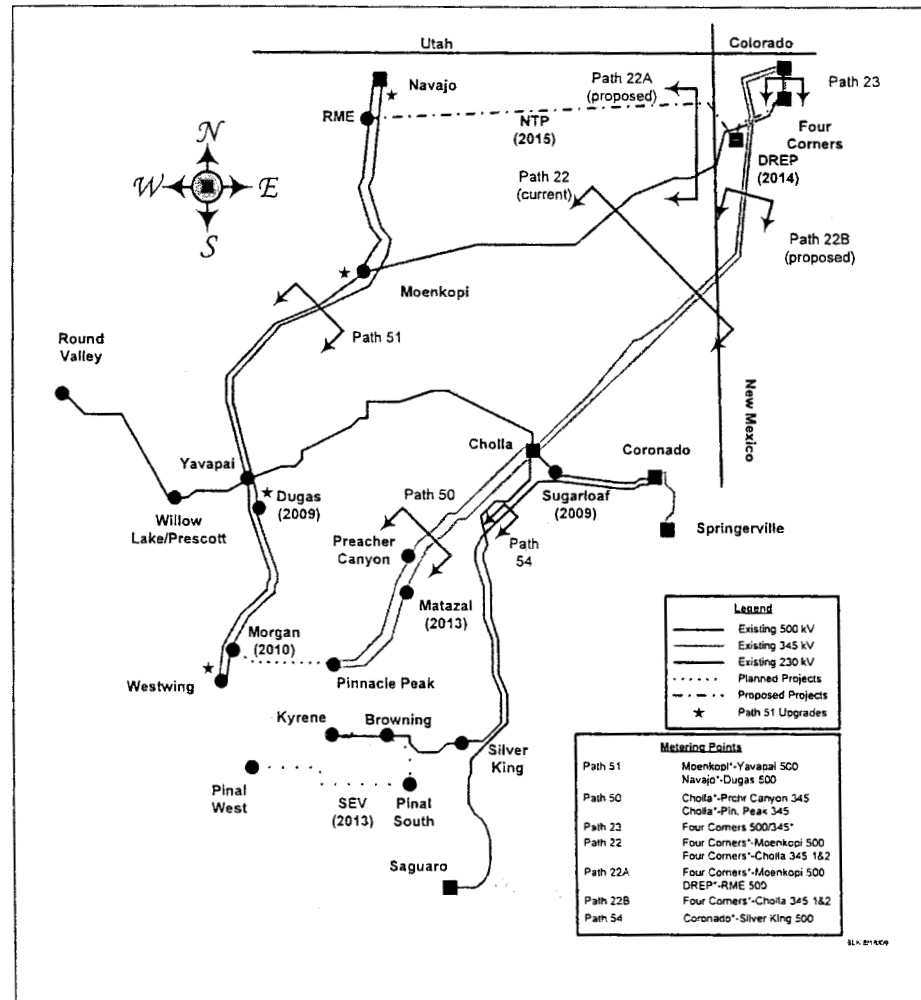
In late 2008, the owners of the path determined that N-2 disturbances within the path had historically occurred and the design of the two lines from Navajo to Westwing switching stations were found to be in a common corridor according the new WECC common corridor definition. Studies were re-run using the approved study plan to determine both a new non-simultaneous rating for the path and to identify any simultaneous relationships resulting from new limiting contingencies. This report represents the Accepted Rating Report study for the Southern Navajo Upgrade Project and establishes a new non-simultaneous rating for Path 51 along with any simultaneous relationships.

Based on the results of studies performed for this Accepted Rating Report, the plan of service for the Southern Navajo Upgrade Project will support a new non-simultaneous rating of 2800 MW for Path 51 while meeting WECC/NERC Planning Standards, WECC Reliability Criteria and local reliability criteria. In addition, no simultaneous limitations with other studied paths were discovered in the course of this study effort other than the relationship found between Path 51 and the Yavapai-Willow Lake 230 kV line. Results from this study have also correlated with the results found in previous studies such as *WECC Comprehensive Progress Report Navajo Transmission Project (Segment 1)*, *WECC Comprehensive Progress Report Southern Navajo (Path 51) Upgrade Project*, *Desert Rock Energy Project System Impact Study Report*, *Southern Navajo Interconnection Study for the Navajo Transmission Project*, *Ormes and*

TS9 Projects and Path 51 Upgrade Feasibility Study Report. The scheduled in-service date for the upgrade project is December 2009.

Figure 1 shows the location of the Path 51, the location of the project components (series capacitors) and some of the relevant paths studied in the analysis.

Figure 1. Geographic map of N. Arizona/NW. New Mexico.



## II. STUDY OBJECTIVES AND PURPOSE

For this study, the primary objective was to determine a new accepted rating for Path 51 as a result of upgrades to four series capacitors associated with the path while following WECC's procedures outlined in *Overview of Policies and Procedures for Regional Planning Project Review, Project Rating Review, and Progress Reports*. As described before, WECC Path 51 is defined as the combined southbound flows on the Navajo-Westwing and Moenkopi-Yavapai 500 kV lines. The northbound rating for the

path is currently undefined. By late 2009 the southern termination of the Navajo-Westwing line will change to the Dugas (formerly known as Ormes) switching station when its construction is completed, however the metering point will remain at Navajo. Using the guidelines of the WECC Project Rating Review procedures, a study plan was drafted and approved through the WATS task force for the performing the analysis for this study. Interested members of the WATS task force participated as a peer review group for this project.

In addition to establishing a new rating for Path 51, the study also assessed impacts of the Southern Navajo upgrades on other proposed projects all within or outside the rating process. Several non-simultaneous sensitivity studies as well as simultaneous analysis were conducted per requests from members of the project review group.

### **III. PROJECT PLAN OF SERVICE AND OTHER MAJOR PROJECTS**

As described earlier, the components of the Southern Navajo Upgrade Project involve upgrades to the four 500 kV series capacitors along the length of the Southern Navajo (Path 51) path. Below is a tentative description of the plan of service for each capacitor and the current status of its construction.

The plan of service in support of the new accepted rating for Path 51 is given below. All banks will be MOV type and will be composed of a single segment.

#### **1. Navajo-Dugas 500 kV Series Capacitors (C3 and C10)**

Increase the ampacity of both the C3 (Navajo) and C10 (Dugas) series capacitors to 1750 amps continuous with a 135%, 30 minute emergency capability from 1137 amps continuous rating. Increase the impedance of both banks from 29.7  $\Omega$  per phase to 40.5  $\Omega$  per phase. In June 2008, the C3 bank was completed and placed into service. In 2009, the C10 (currently located at the Westwing switchyard) is scheduled to be decommissioned and a new bank is planned to be built at the new Dugas 500/69 kV substation. The new bank at Dugas will be known as the C10 bank.

#### **2. Westwing-Yavapai 500 kV Series Capacitor (C9)**

Increase the ampacity of the C9 bank located at the Westwing switchyard to 1750 amps continuous from 1219 amps, with a 30 minute emergency capability of 2362 amps. Increase the impedance from 20.64  $\Omega$  per phase to 25.7  $\Omega$  per phase. In April 2007, the C9 bank was rebuilt and placed in-service.

#### **3. Moenkopi-Yavapai 500 kV Series Capacitor (C6)**

Increase the ampacity of the C6 bank from 1524 amps to 2250 amps continuous with a 135%, 30 minute emergency capability and increase the impedance of the bank to 25.7  $\Omega$  per phase. In June 2006, the C6 bank was rebuilt to 1750 amps continuous and 16.5  $\Omega$

per phase. The upgrade from 1524 amps to 2250 amps and 25.7  $\Omega$  per phase is scheduled to be completed by October 2009. Table 1 shows the summary of the upgrades.

Table 1. Existing and proposed compensation levels.

Series Bank	Ampacity		Compensation		New Facility	
	Existing	Planned	Existing	Planned	Rating	Segments
C3 (NV-DG)	1137/1530 A	1750/2362 A	29.7 $\Omega$ /23.9%	40.5 $\Omega$ /32.6%	372 MJ	1
C10 (NV-DG)	1137/1530 A	1750/2362 A	29.7 $\Omega$ /23.9%	40.5 $\Omega$ /32.6%	372 MJ	1
C6 (MK-YP)	1524/2057 A	2250/3037 A	16.5 $\Omega$ /27.1%	25.7 $\Omega$ /42.3%	390 MJ	1
C9 (YP-WW)	1219/1645 A	1750/2362 A	20.6 $\Omega$ /40.0%	25.7 $\Omega$ /49.8%	236 MJ	1

Additionally, several large transmission upgrade/construction projects associated with Path 51 were included in all cases of the study due to their in-service dates preceding or coinciding with the upgrade of the capacitors. These projects include the Dugas 500/69 kV substation, the Morgan (formerly referred to as TS9) 500 kV switching station and the 500 kV reactor replacement project. Study results assessing the impacts of these projects can be found in the following report "*Southern Navajo Interconnection Study for the Navajo Transmission Project, Ormes and TS9 Projects*".

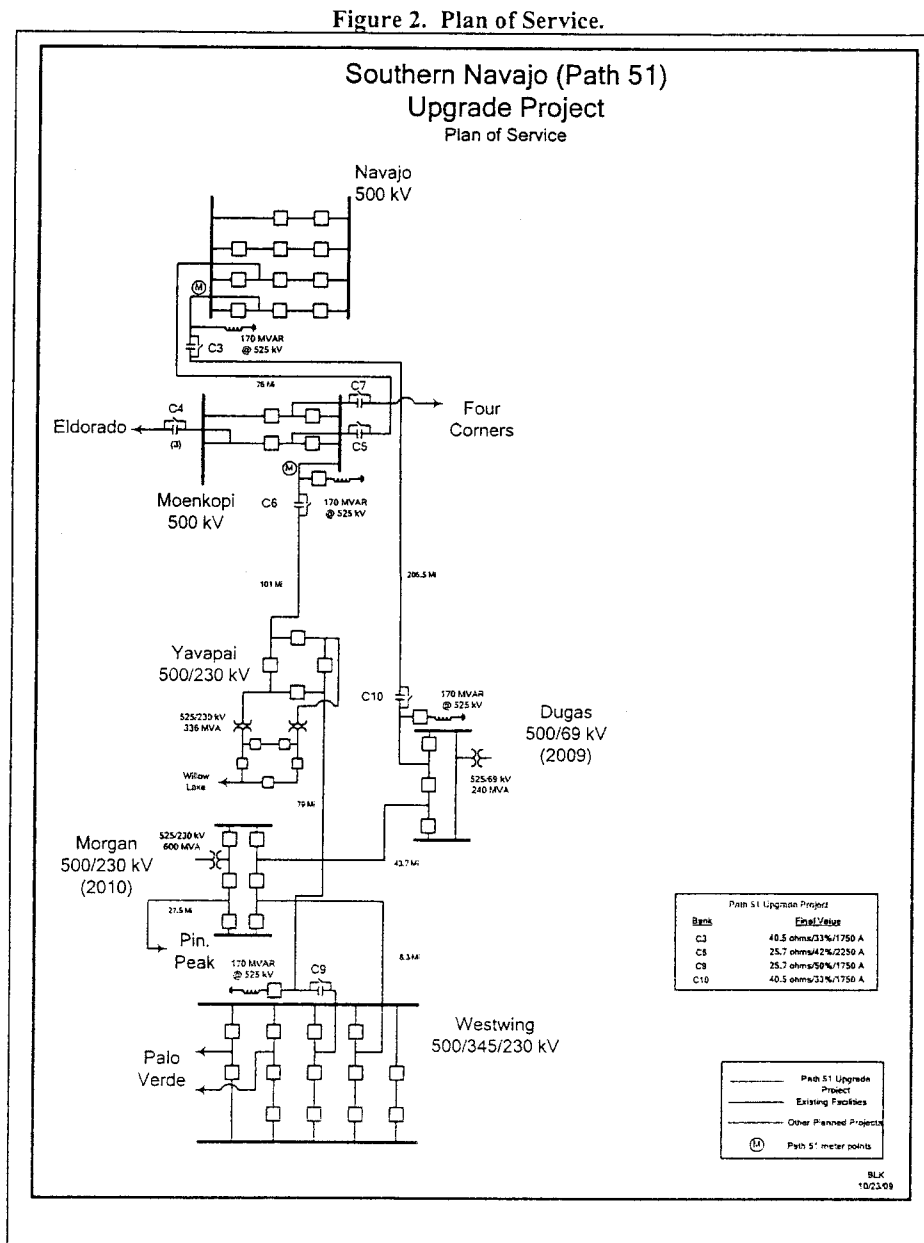
Since the Devers-Palo Verde # 2 (DPV2) and the EOR9300 projects have achieved phase three status allowing Path 49 to achieve a new accepted rating, both projects were included in Path 51 upgrade Accepted Rating study. Both projects have in-service dates in the 2009-2010 time frames with a combined non-simultaneous/simultaneous rating of 10,500 MW for the East of the River path. However, in early 2009, the project sponsors decided to indefinitely postpone the Arizona portion of the DPV2 project. Consequently, a non-simultaneous sensitivity case was built with DPV2 in-service and Path 51 at 2800 MW. All other cases did not include the DPV2 project. This was done in lieu of representing the project in all study cases as initially outlined in the study plan. A detailed description of the plan of service for both the DPV2 and EOR9300 projects and the study results supporting the changes to the Path 49 non-simultaneous rating can be found in the "*Combined Devers-Palo Verde No. 2 Project and EOR9300 MW Upgrade Project*" report.

The addition of Springerville unit #4 and its associated transmission improvements will be completed by winter 2009-2010. As a result of these system changes, Path 54 achieved a new accepted rating of 1494 MW as of October 2007. This project has been included in all non-simultaneous and simultaneous cases. A description of the components of the plan of service for this project can be found in the approved study plan in Appendix A as well as the report "*Final Report for Springerville Unit 4 and Rating of Path 54*".

Due to its proximity to the Southern Navajo system, a non-simultaneous sensitivity was performed with Path 51 at 2800 MW with the Desert Rock Energy Project (DREP) and segment 1 of the Navajo Transmission Project (NTP) in-service. Maximum output of the plant along with high flows on NTP was modeled for this sensitivity. Several studies have been performed on the effects of DREP and NTP on the adjacent

transmission system. Elements for both these projects are given in the study plan with study results provided in the reports “Desert Rock Energy Project System Impact Study Report” and “WECC Comprehensive Progress Report Navajo Transmission Project (Segment 1)”.

Figure 2 shows the plan of service for the Southern Navajo Upgrade Project.



Finally, the ON Line (formerly known as En-Ti) project was modeled as a simultaneous sensitivity with flows at 2000 MW and Path 51 flows at 2800 MW. The ON Line project has an in-service date of late 2012 and is currently in phase II of the

WECC Project Rating Review process. In addition, Path 81 (Centennial Project) was modeled at 3000 MW for this case. A detailed description of plan of service for the ON Line project can be found in the transmission plan for Nevada Power's Triennial Integrated Resource Plan for 2010-2029.

#### IV. NON-SIMULTANEOUS RESULTS

The purpose of the non-simultaneous analysis for this report is to verify the results from the WECC comprehensive progress report for the sponsored project, to incorporate suggestions from project review group members and to provide a reference for subsequent simultaneous analysis. However because of changes to outage criteria in the Southern Navajo path and subsequent changes to the critical contingencies and limiting elements, a new non-simultaneous rating for Path 51 needed to be established. Pre- and post-project non-simultaneous cases were reviewed by Project Review group members.

Table 2 shows a summary of cases constructed and used to study the non-simultaneous conditions outlined in the study plan. Table 3 shows a listing of cases used in the study along with detailed actual flow levels.

Table 2. Non-simultaneous case summary and flow targets.

Case Description	Path Flows	Cases
Pre-project non-sim.	Path 51 @ 2264	p51_101d/5/2
Post-project non-sim.	Path 51 @ 2800	p51_109h/5/2
Post-project non-sim w/ DPV2	"	p51_107j/5/2
Post-project non-sim w/ NTP & DREP	"	p51_115d/5/2

For all scenarios studied, the thermal results of the analyses show:

1. No transmission element pre-disturbance was loaded above its continuous rating.
2. No transmission element was loaded above its emergency rating for single (N-1) or double (N-2) contingency outages.



3. No N-1 outage violated the 5% post-disturbance criteria or produced negative margin.
4. No N-2 contingency violated the 10% post-disturbance criteria or produced negative margin.

Results from the post-transient voltage and reactive margin analysis for the non-simultaneous scenario show that the plan of service for Path 51 upgrade project meets the WECC/NERC Planning Standards and local reliability criteria. Appendix B lists the summary results for the thermal analysis and Appendix C provides the results for the post-transient analysis.

Transient stability results for the non-simultaneous analysis have shown that the plan of service of the Southern Navajo Upgrade Project meets the WECC/NERC Planning Standards and local reliability criteria for damping, frequency and voltage performance. Studies were performed on the original non-simultaneous case and the 7% generation margin cases for the Navajo plant according to the guidelines put forth in the approved study plan. A summary of the results from the original non-simultaneous cases and the Navajo generation margin cases can be found in Appendix B.

1. No single-contingency outage violated voltage, frequency or damping criteria for the original non-simultaneous cases and the Navajo margin cases studied.
2. No double-contingency outage violated voltage, frequency or damping criteria for the original non-simultaneous and the Navajo margin cases studied.

Table 3. Detailed non-simultaneous case summary.

Cases	Analysis	Path 51	Path 22A	Path 22B	Path 50	Path 54	Path 49	FCGS	NGS	DREP
<i>PS1_101d</i>	TH, TS	2266	619	983	635	985	916	2060	2243	-
<i>p51_101d5</i>	PT	2384	609	1005	644	1000	436	2060	2243	-
<i>p51_101d2</i>	PT	2327	616	997	641	994	641	2060	2243	-
<i>p51_101dnm</i>	TS	2345	620	1000	645	995	988	2060	2413	-
<i>PS1_107j</i>	TH, TS	2803	673	1193	678	1135	-1479	1445	2083	-
<i>p51_107j5</i>	PT	2943	749	1248	810	1163	-1471	1615	2243	-
<i>p51_107j2</i>	PT	2874	662	1200	784	1138	-1473	1445	2213	-
<i>p51_107jnm</i>	TS	2971	648	1209	790	1142	-1411	1445	2413	-
<i>PS1_109h</i>	TH, TS	2801	790	1261	759	1068	-1033	1645	2083	-
<i>p51_109h5</i>	PT	2941	856	1316	786	1090	-1023	1815	2243	-
<i>p51_109h2</i>	PT	2875	778	1267	763	1072	-1027	1645	2213	-
<i>p51_109hnm</i>	TS	2975	763	1276	768	1079	-963	1645	2413	-
<i>PS1_115d</i>	TH, TS	2806	703	1105	686	987	296	560	2083	1400
<i>p51_115d5</i>	PT	2942	1422	1142	707	1007	309	685	2243	1400
<i>p51_115d2</i>	PT	2873	1347	1113	691	991	303	560	2203	1400
<i>p51_115dnm</i>	TS	2975	1326	1125	699	997	366	560	2413	1400

#### IV.A Path 51 @ 2264 MW

##### Power flow/thermal analysis

After performing the analysis as described in the study plan with Path 51 at 2264 MW (p51\_101d), the results of the thermal analyses show that the plan for the upgrade project meets the NERC/WECC Planning Standards for this pre-project case.

For the planning scenario with Path 51 flows at their present accepted rating no post-disturbance loadings above 90% were recorded. Appendix B gives the thermal results for this non-simultaneous scenario.

#### **Post-transient voltage and reactive margin analysis**

For the non-simultaneous case with Path 51 flows at 2264 MW, no single contingencies violated the 5% voltage criteria for the 105% flow case. Also, no N-2 outages caused voltages to exceed the 10% criteria for the 102.5% case. Of all the contingencies taken, all outage cases solved and demonstrated positive margin.

#### **Transient stability analysis**

The transient stability assessment of both the base case and the Navajo generation margin case revealed no violations of either planning standards or local reliability criteria for single and double contingency outages. Appendix C provides a complete listing of the post-transient and transient results from the analysis.

### **IV.B Path 51 @ 2800 MW**

#### **Power flow/thermal analysis**

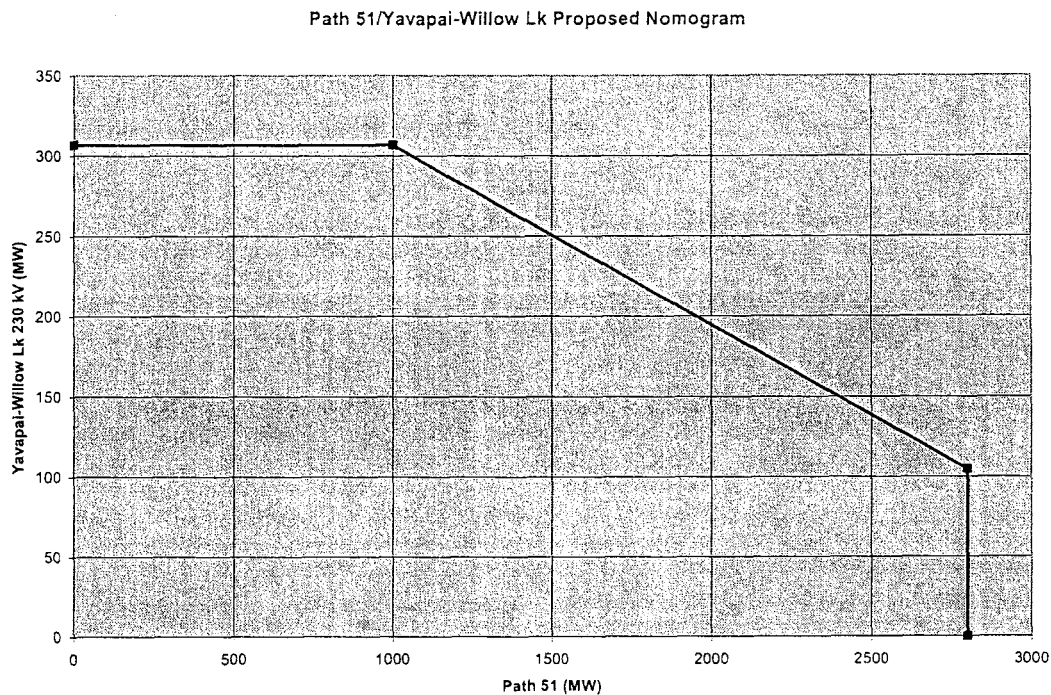
The ability of Path 51 to reach its non-simultaneous limit of 2800 MW is related to pre-disturbance flows on the Yavapai-Willow Lake 230 kV line. This internal simultaneous relationship is given in Fig. 3 below. Operating experience has shown that the nomogram has not been violated even with the change on outage criteria of the path from N-1 to N-2 is considered. The non-simultaneous rating of the Yavapai-Willow Lake line is 307 MW.

With Path 51 at its proposed non-simultaneous rating, the limiting thermal contingencies were (p51\_109h):

- a) Loss of the Moenkopi-Yavapai and Navajo-Dugas 500 kV lines caused the Round Valley-Prescott 230 kV line to reach 99.3% of its emergency rating.
- b) An N-2 outage of the Yavapai-Westwing and Navajo-Dugas 500 kV lines caused the Yavapai-Willow Lake 230 kV line to load to 99.7% of its emergency rating.

Table B in Appendix B provides a more thorough list of power flow results for this case.

Figure 3. Path 51/Yavapai-Willow Lake Nomogram.



#### Post-transient voltage and reactive margin analysis

No N-1 contingencies violated the WECC/NERC Planning standards for the 105% case. No double contingencies violated the 10% criteria for the 102.5% flow case. For the reactive margin analysis, all cases solved with positive margin on the measured buses. A summary of post-transient results can be found in Appendix C.

#### Transient stability analysis

For both the 2800 MW non-simultaneous case and its associated Navajo margin case, no single or double contingencies were found to violate planning standards or reliability criteria. Appendix C gives a summary of the transient results for the Path 51 non-simultaneous case at its proposed rating.

#### IV.C Path 51 @ 2800 MW w/ Devers-Palo Verde # 2

##### Power flow/thermal analysis

As was described earlier, a modified case (p51\_107j) was built with the Devers-Palo Verde No. 2 project added to the post-project non-simultaneous (p51\_109h). The following limiting contingencies and their effects were:

- a) An outage of the Yavapai-Westwing and Navajo-Dugas 500 kV lines forced the Yavapai-Willow Lake 230 kV line to load to 99.7% of its emergency rating.
- b) Loss of the Moenkopi-Yavapai and Navajo-Dugas 500 kV lines resulted in the Round Valley-Prescott line to load to 99.3% of its emergency rating.

Appendix B contains a summary of the thermal results for the DPV2 sensitivity.

#### **Post-transient voltage and reactive margin analysis**

For the 105% margin case, no outages were found to violate the 5% voltage criteria. Also, no double contingency outages were found to violate the 10% voltage criteria for the 102.5% margin case. In the reactive margin analysis, all contingency cases solved and the monitored buses were found to have positive margin. Results from all outages taken can be found in Appendix C.

#### **Transient stability analysis**

No simulated disturbances were found that violated planning standards or reliability criteria for the base case and the Navajo 7% generation margin scenarios of the sensitivity case with the DPV2 project. Both post-transient and transient stability result summaries can be found in Appendix C for this sensitivity.

### **IV.D Path 51 @ 2800 MW w/ NTP & DREP**

#### **Power flow/thermal analysis**

Another sensitivity scenario was performed with the addition of the Desert Rock Energy Project and the Navajo Transmission Project segment 1 to the post-project Path 51 non-simultaneous case. The critical contingency and limiting element for this case was:

- a) The Yavapai-Westwing 230 kV loads to 99.6% of its emergency rating for the N-2 loss of the Navajo-Dugas and Yavapai-Westwing 500 kV lines.

#### **Post-transient voltage and reactive margin analysis**

For the Desert Rock and Navajo Transmission Project non-simultaneous sensitivity, no single-contingency or double contingency outages resulted in voltage violations in excess of 5% and 10%, respectively. No reactive margin violations were recorded as well and all cases solved. Results from each outage can be found in Appendix C.

#### **Transient stability analysis**

All simulation results for the NTP sensitivity case (base case plus Navajo generation margin case) met both WECC/NERC Planning Standards and local reliability criteria. A listing of the results from the post-transient and transient analysis can be found in Appendix C.

## V. SIMULTANEOUS RESULTS

Study results show that the plan of service for the Path 51 Upgrade Project does not have any simultaneous interactions with the paths and conditions agreed to in the approved study plan (Appendix A). Table 4 shows a summary of cases constructed and used to study the simultaneous conditions outlined in the study plan along with flow targets. Table 5 shows a listing of cases used in the study along with detailed actual flow levels.

Table 4. Simultaneous cases and target levels.

Paths/Projects	Components	Path Flow Targets	Case
Path 50 & 54	-Cholla*-Prchr Cnyn 345 kV -Cholla*-Pinn Pk 345 kV -Cornado*-Slvr Kng 500 kV	Path 50/54 @ 1200/1494(1)	p51_121p
Path 35	-Red Butte-H. Allen 345 kV (mt. pt is H. Allen 500 kV)	Path 35 @ 300	p51_111e
Path 77	-Crystal 500*/230 kV #1 & #2	Path 77 @ 950	p51_113g
Path 81 & ON Line	-H. Allen*-Crystal 500 kV -Lenzie-Northwst* 500 kV -Sunrise-Mead* 500 kV -Rob. Smt*-H. Allen 500 kV	ON Line/Path 81 @ 2000/3000	p51_125c

Note 1: Path 50 flows held as high as possible so as to not exceed the SOL of the path.  
\* Indicates metering point.

Table 5. Simultaneous cases and actual levels.

Cases	Analysis	Path 51	Path 22A	Path 22B	Path 50	Path 54	Path 49	FCGS	NGS	EAZ(1)
p51_121p	TH, TS, PT	2801	965	1162	1119	1493	113	1865	2223	3211
p51_111e	TH, TS, PT	2802	789	1260	759	1068	-1033	1645	2083	2409
p51_113g	TH, TS, PT	2800	791	1260	759	1069	-835	1645	2243	2409
p51_125c	TH, TS, PT	2801	1017	1272	919	1272	-34	2060	2233	3009

1 Net sum of the Cholla, Coronado and Springerville generation.

After performing the analysis described in the approved study plan on the simultaneous cases listed in Table 4, the results of the thermal analysis show that the

plans of service for the combined interconnectors meet NERC/WECC Planning Standards and local reliability criteria. Appendix B gives the thermal results for all four simultaneous scenarios.

A listing below highlights the thermal results of the studies performed according to the study plan.

1. No transmission element pre-disturbance was loaded above its continuous rating.
2. No transmission element was loaded above its emergency rating for single or double contingency outages.

Post-transient results for all three simultaneous cases show that the proposed plans of service for the Path 51 Upgrade Project meets the WECC/NERC Planning Standards and local reliability voltage and reactive margin criteria.

1. No single contingency violated the 5% post-disturbance criteria or produced negative margin.
2. No double contingency resulted in exceeding the 10% post-disturbance criteria or produced negative margin.

Results from the transient stability analysis for the proposed plans of service for the Path 51 Upgrade Project demonstrate that the WECC/NERC Planning Standards and local reliability criteria were not violated. A summary of the results from the post-transient and transient stability analyses performed for each simultaneous scenario can be found in Appendix C.

1. No N-1 disturbance exceeded voltage, frequency or damping criteria for any of the scenarios studied.
2. No N-2 disturbance exceeded voltage, frequency or damping criteria for any of the scenarios studied.

The following descriptions provide more detail regarding the simultaneous scenarios studied.

#### **V.A Path 50 & 54**

##### **Power flow/thermal analysis**

For the simultaneous case with Path 51 at its proposed rating and Paths 50 and 54 at their present accepted ratings, the thermal analysis showed no post-disturbance flows above the emergency ratings of any adjacent lines. Under N-0 conditions, the Cholla-

Pinnacle Peak 345 kV was loaded to 97.3% of its normal rating. Two of the more critical contingencies are listed below:

- a) An outage of the Moenkopi-Yavapai 500 kV and Navajo-Dugas 500 kV lines loads the Yavapai-Willow Lake 230 kV line to 100.0% of its emergency rating.
- b) An outage of the Cholla-Pinnacle Peak 345 kV line resulted in the Cholla-Preacher Canyon 345 kV line loading to 95.4% of its emergency rating.

A more thorough listing of the results can be found in Appendix B.

#### **Post-transient voltage and reactive margin analysis**

The post-transient analysis revealed no single or double contingency outages violating WECC/NERC Planning Standards for the 5% and 10% voltage drop criteria. Additionally, all contingency cases solved and all the monitored buses demonstrated positive margin.

#### **Transient stability analysis**

None of the simulated disturbances for the Path 51 vs. Path 50/54 simultaneous case were found to violate WECC/NERC Planning Standards for the proposed plan of service. Appendix C shows a summary of the contingencies taken as well as the results.

### **V.B Path 35**

#### **Power flow/thermal analysis**

Power flow results for the simultaneous case of Path 51 vs. TOT 2C demonstrated that the proposed plan of service for the upgrade to the Southern Navajo project did not violate planning standards or local reliability criteria. Appendix C contains a summary of the most limiting contingencies for this case, however the two of the more severe outages are shown below:

- a) The Yavapai-Willow Lake 230 kV line loads to 99.8% of its emergency rating of 890 amps for loss of the Yavapai-Westwing and Navajo-Dugas 500 kV line.
- b) Loss of the Navajo-Dugas and Moenkopi-Yavapai 500 kV lines caused the Round Valley-Prescott 230 kV line to load to 99.5% of its emergency rating.

Appendix C contains a more complete listing of the critical outages for this case.

#### **Post-transient voltage and reactive margin analysis**

No single or double contingency outages simulated for this case violated WECC/NERC Planning Standards or local reliability criteria for the upgrade project plan of service. All outages cases solved and each of the monitored buses exhibited positive margin.

#### **Transient stability analysis**

All of the simulated disturbances for the TOT2C simultaneous case modeling Path 51 at 2800 MW demonstrated that the project's plan of service met WECC/NERC Planning Standards. Results for all the outages simulated for this case can be found in Appendix C.

#### **V.C Path 77**

##### **Power flow/thermal analysis**

Under the scenario of Path 51 at 2800 MW while Path 77 (Crystal 500/230 kV) is at 950 MW, no thermal overloads were encountered that violated NERC/WECC Planning Standards. As before, two of the more severe are provided below:

- a) A simulated outage of the Navajo-Dugas and Moenkopi-Yavapai 500 kV lines caused the Round Valley-Prescott 230 kV line to load to 794 amps or 99.3% of its emergency rating.
- b) Loss of the Yavapai-Westwing and Navajo-Dugas 500 kV lines caused the Yavapai-Willow Lake 230 kV line to load to 99.8% of its emergency rating.

Appendix B lists other contingencies performed for this case.

##### **Post-transient voltage and reactive margin analysis**

No single or double contingency outages simulated for this case violated WECC/NERC Planning Standards or local reliability voltage criteria for the upgrade project plan of service. All outages cases solved and each of the monitored buses exhibited positive margin.

#### **Transient stability analysis**

All of the simulated disturbances for the TOT2C simultaneous case modeling Path 51 at 2800 MW demonstrated that the project's plan of service met WECC/NERC Planning Standards. Results for all the outages simulated for this case can be found in Appendix C.

#### **V.D Path 81 & ON Line**



### **Power flow/thermal analysis**

This case was coordinated with Sierra Pacific to represent 3000 MW on the Centennial Project (Path 81), 2000 MW on the proposed ON Line project and 2800 MW on Path 51. Thermal results for this simultaneous case found no single or double contingencies violated WECC/NERC Planning Standards. Although a summary of the more critical disturbances can be found in Appendix B, three of the most critical outages are shown below:

- a) Outage of the Moenkopi-Yavapai and Navajo-Dugas 500 kV lines caused the Round Valley-Prescott 230 kV line to load to 88.0% of its emergency rating.
- b) Loss of the Yavapai-Westwing and Navajo-Dugas 500 kV lines caused the Willow Lake-Yavapai 230 kV line to load to 99.9% of its emergency rating.
- c) The Arden-Tolson 230 kV line loaded to 100% of its emergency rating for an outage of the Lenzie-Northwest 500 kV line.

### **Post-transient voltage and reactive margin analysis**

No violations of WECC/NERC Planning Standards were found for the N-1 and N-2 outages taken in the post-transient analysis. All cases solved and all the monitored buses were found to have positive reactive margin.

### **Transient stability analysis**

All simulations for the outages studied were found to meet voltage and frequency NERC/WECC Planning standards and local reliability criteria for this case. All disturbances were found to exhibit positive damping. A summary of all the disturbances studied for the post-transient and transient analysis can be found in Appendix C.

## **VI. SSR RESULTS**

In the previous study *Southern Navajo Interconnection Study for the Navajo Transmission Project, Ormes and TS9 Projects* report the effects of the series capacitor upgrades on the Navajo Generating Station were evaluated. Based on recent SSR studies, APS believes that there will be little or no effect on the Navajo Generating Station as a result of the four capacitors being upgraded.

Additionally, APS believes there will be negligible subsynchronous resonance effects from the Path 51 series capacitor upgrades on existing and proposed adjacent transmission facilities such as the Centennial Project or the proposed On Line project. As a result this assessment, APS plans no further SSR work at this time.

## VII. SCHEDULE

The following is a schedule of activities for the Southern Navajo Upgrade Project. Table 6 gives the milestones for the project including dates.

- Submit Draft Study Plan for review to SN/PRG participants – 6/08
- Submit non-simultaneous base cases for review – 7/08
- Present non-simultaneous results to SN/PRG participants – 9/08
- Present simultaneous results to SN/PRG participants – 10/09
- Draft report to SN/PRG participants – 10/09
- Submit ARR report to WECC members (PCC, TSS & OC) – 10/09

Table 6. Project activities and schedule.

Activity	Anticipated Completion Date
Path 51 Upgrade Feasibility Study Report	Completed – 10/2005
Initiate WECC Project Rating Review process	Completed – 6/2006
C6 rebuilt to 1750 A (MK-YA @ MK)	Completed – 6/2006
C9 rebuilt to 25.7 $\Omega$ , 1750 A (YA-WW @ WW)	Completed – 4/2007
Issue Path 51 Upgrade CPR(1) to WECC	Completed – 8/2007
WECC Phase II status granted.	Completed – 11/2007
S. Navajo Interconnectors Study Report	Completed - 5/2008
C3 rebuilt to 40.5 $\Omega$ , 1750 A (NV-DG @ NV)	Completed - 6/2008
Finalize ARR Study Plan	Complete – 8/2008
C6 upgraded to 25.7 $\Omega$ , 2250 A (MK-YA @ MK)	Complete – 10/2009
Issue Path 51 Upgrade ARR(2) to WECC	10/2009
C10 rebuilt to 40.5 $\Omega$ , 1750 A (NV-DG @ DG)	12/2009
WECC Phase III status granted.	12/2009
Commercial operation/rating availability.	12/2009

(1) Comprehensive Progress Report.

(2) Accepted Rating Report.

## VIII. CONCLUSIONS

Results from the power flow, post-transient stability, transient stability and SSR analyses demonstrate that the plan of service for the Southern Navajo (Path 51) Upgrade Project supports the proposed rating and will not violate WECC/NERC Planning Standards or local reliability criteria. At the proposed non-simultaneous rating of 2800 MW, Path 51 was found not to have any simultaneous relationships with the adjacent paths suggested per the approved study plan.

Studies were conducted using the study plan approved from the project's rating review group, the Western Arizona Transmission System (WATS) task force, stakeholder input, WECC reliability criteria, local reliability criteria and Navajo Operating Study Criteria. Initially, the project sponsors performed studies using only N-1 contingencies which allowed the plan of service to support a rating of 3200 MW. This was essentially the result found in the comprehensive progress report. However, an examination of the paths outage history along with a review of the corridor width required changing the critical contingencies to loss of the Yavapai-Westwing/Navajo-Dugas 500 kV lines and the Moenkopi-Yavapai/Navajo-Dugas 500 kV lines. As a consequence, the non-simultaneous rating decreased to 2800 MW. The Southern Navajo participants will continue to study methods of mitigating the interaction (Fig. 3) between Path 51 and the Yavapai-Willow Lake line.

## **Appendix A**

### **Study Plan**

## **Appendix B**

### Thermal Results

## **Appendix C**

### Transient and Post-transient Results